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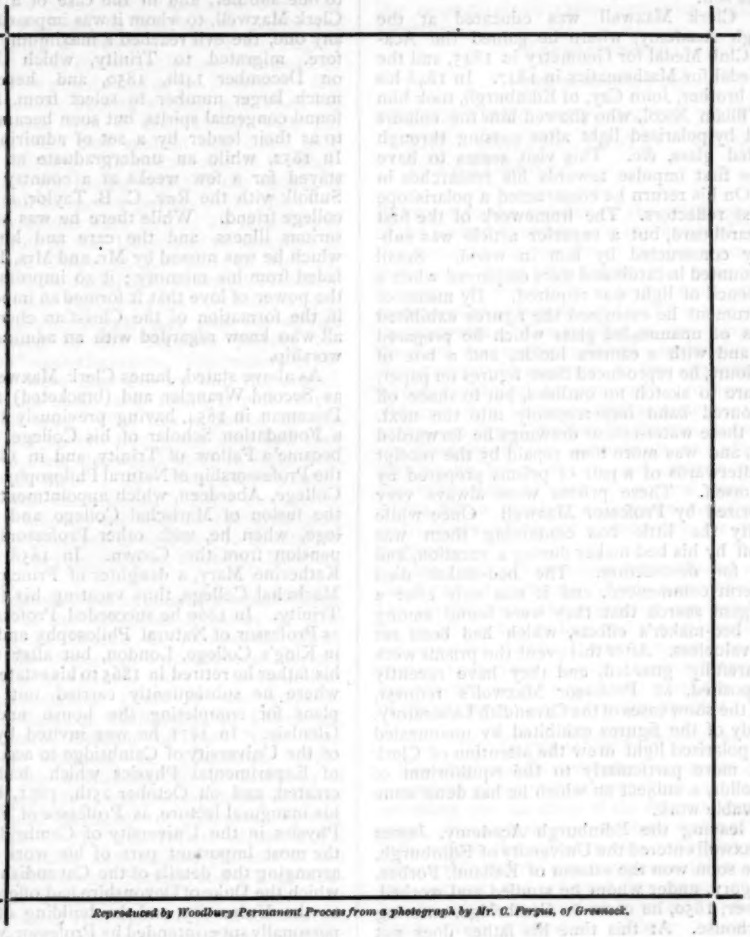

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JAMES CLERK MAXWELL, F.R.S.*

JAMES CLERK MAXWELL was born in 1831, being the only son of John Clerk Maxwell, Esq., of Middlebie. His grandfather was Captain James Clerk of Penicuik, whose two sons were the Right Hon. Sir George Clerk, Bart., of Penicuik, and the above-mentioned, John Clerk Maxwell. Captain James Clerk was a younger brother of Sir John Clerk of Penicuik, and on the death of the latter, Sir George Clerk succeeded to the estate of Penicuik, while John succeeded to the

* This being the best memoir of Professor Maxwell written, we are induced, with the permission of the Editors of *Nature*, to reprint it in full. We are also indebted to the author for his kindness in revising same.—ED. TEL. JOUR.

estate of Nether Corsock, part of the Middlebie estate, which had come into the family through marriage, in a previous generation, with Agnes Maxwell. Along with this estate John Clerk assumed the family name of Maxwell. When James Clerk Maxwell was eight years old his mother died, and his father, who had been called to the Scotch Bar, but never practised as an advocate, lived a retired life, devoting himself to the care of his estates, and of his son.

James Clerk Maxwell was educated at the Edinburgh Academy, where he gained the Academical Club Medal for Geometry in 1845, and the Silver Medal for Mathematics in 1847. In 1848 his mother's brother, John Cay, of Edinburgh, took him to see William Nicol, who showed him the colours exhibited by polarised light after passing through unannealed glass, &c. This visit seems to have given the first impulse towards his researches in optics. On his return he constructed a polariscope with glass reflectors. The framework of the first was of cardboard, but a superior article was subsequently constructed by him in wood. Small lenses mounted in cardboard were employed when a conical pencil of light was required. By means of this instrument he examined the figures exhibited by pieces of unannealed glass which he prepared himself, and with a camera lucida, and a box of water colours, he reproduced these figures on paper, taking care to sketch no outlines, but to shade off each coloured band imperceptibly into the next. Some of these water-colour drawings he forwarded to Nicol, and was more than repaid by the receipt shortly afterwards of a pair of prisms prepared by Nicol himself. These prisms were always very highly prized by Professor Maxwell. Once while at Trinity the little box containing them was carried off by his bed-maker during a vacation, and destined for destruction. The bed-maker died before term commenced, and it was only after a very diligent search that they were found among the late bed-maker's effects, which had been set aside as valueless. After this event the prisms were most carefully guarded, and they have recently been deposited, at Professor Maxwell's request, in one of the show cases of the Cavendish Laboratory. The study of the figures exhibited by unannealed glass in polarised light drew the attention of Clerk Maxwell more particularly to the equilibrium of elastic solids, a subject on which he has done some very valuable work.

After leaving the Edinburgh Academy, James Clerk Maxwell entered the University of Edinburgh, where he soon won the esteem of Kelland, Forbes, and Gregory, under whom he studied and worked. In October, 1850, he came to Cambridge, entering at Peterhouse. At this time his father does not seem to have been very sanguine respecting the advantages to be derived from a Cambridge course, but his opinion of the University rose considerably when in 1854 the examiners showed their appreciation of his son by making him Second Wrangler, and bracketing him as first Smith's Prizeman. Clerk Maxwell remained but one term at Peterhouse. There was little chance of his obtaining a Fellowship without considerable delay, on account of the few vacancies likely to occur, and this consideration induced his college tutor, purely out of regard to Clerk Maxwell's interest, to recommend his migration. Other considerations, however, seemed to influence Clerk Maxwell himself. In every college there are always idlers to be found, who amuse themselves by "dropping in" upon men at all hours. In a large college a man selects his own friends, and the idlers can indulge their favourite habit with the least possible injurious effect by "dropping in" upon one another. But in a small college, where all the undergraduates are known to one another, and in the case of a student like Clerk Maxwell, to whom it was impossible to grieve any one, the evil reached a maximum. He, therefore, migrated to Trinity, which he entered on December 14th, 1850, and here, having a much larger number to select from, he not only found congenial spirits, but soon became looked up to as their leader by a set of admiring followers. In 1852, while an undergraduate at Trinity, he stayed for a few weeks at a country vicarage in Suffolk with the Rev. C. B. Taylor, a brother of a college friend. While there he was attacked by a serious illness, and the care and kindness with which he was nursed by Mr. and Mrs. Taylor never faded from his memory; it so impressed him with the power of love that it formed an important factor in the formation of the Christian character which all who knew regarded with an admiration akin to worship.

As above stated, James Clerk Maxwell graduated as Second Wrangler and (bracketed) first Smith's Prizeman in 1854, having previously been elected a Foundation Scholar of his College. In 1855 he became a Fellow of Trinity, and in 1856 obtained the Professorship of Natural Philosophy in Marischal College, Aberdeen, which appointment he held till the fusion of Marischal College and King's College, when he, with other Professors, received a pension from the Crown. In 1858 he married Katherine Mary, a daughter of Principal Dewar of Marischal College, thus vacating his fellowship at Trinity. In 1860 he succeeded Professor Goodeve as Professor of Natural Philosophy and Astronomy in King's College, London, but after the death of his father he retired in 1865 to his estate in Scotland, where he subsequently carried out his father's plans for completing the house and offices at Glenlair. In 1871 he was invited by the Senate of the University of Cambridge to accept the Chair of Experimental Physics which had just been created, and on October 25th, 1871, he delivered his inaugural lecture as Professor of Experimental Physics in the University of Cambridge. At first the most important part of his work consisted in arranging the details of the Cavendish Laboratory which the Duke of Devonshire had offered to present to the University, and the building of which was personally superintended by Professor Maxwell from first to last. The whole of the arrangements which rendered the Cavendish Laboratory so admirably adapted for physical investigations, are due to the care and forethought of Professor Clerk Maxwell. When the building had been completed and formally presented to the University, the Duke of Devonshire further signified his desire to provide it with a complete equipment of apparatus, and all this was procured under the personal supervision of the Professor. In 1872 he was elected Honorary Fellow of Trinity College, Cambridge.

During last winter Professor Maxwell did not

enjoy his usual health. In the spring he was unable to carry on his work with his accustomed vigour, but when he left Cambridge for Scotland his friends supposed that with mental rest and physical exercise his health would be restored, and did not regard his indisposition as other than temporary. In Scotland, however, his health did not improve, he suffered much pain and was unable to take his usual food. At length by the advice of his medical attendants, and of Professor Saunders of Edinburgh, one of his former fellow-students, he returned to Cambridge in the beginning of October. Under Dr. Paget's care he at first made considerable improvement and some hopes were entertained of his recovery. He, however, gradually became weaker, and when Dr. Humphry visited him in conjunction with Dr. Paget, it was plain that medical skill could only alleviate his suffering. He died at noon on Wednesday, November 5th, having retained the conscious possession of all his mental powers to the last.

General invitations were sent to all members of the electoral roll of the University to assemble in Trinity College Chapel at 4.30 p.m. on Monday, Nov. 10th, and were numerously accepted, especially by heads of houses (including the Vice-Chancellor), and by professors. About 4.45 p.m. the service was commenced by Mr. Stanford playing the "Dead March" upon the organ. The remains of the late professor were then carried into the chapel, preceded by the choir, and the first part of the Burial Service read. This was followed by the anthem, "If we believe that Jesus died and rose again, even so them also which sleep in Jesus shall God bring with him. . . . Wherefore comfort one another with these words." After the service the assembly followed the body to the great gate, whence it was conveyed to Scotland to be interred in the family burying-place at Corsock, Kirkcudbrightshire.

Professor Maxwell was appointed Foreign Honorary Member of the American Academy of Arts and Sciences of Boston in November, 1874; Member of the American Philosophical Society of Philadelphia in October, 1875; Correspondent in the Mathematical Class to the Imperial Academy of Sciences, Göttingen, in December, 1875; Honorary Member of the New York Academy of Sciences, in December, 1876; Associate of the Amsterdam Royal Academy of Sciences in April, 1877; and Corresponding Member of the Imperial Academy of Sciences, Vienna, in August, 1877. He was Fellow of the Royal Societies of London and Edinburgh, and of the Cambridge Philosophical Society, and a large contributor to the Transactions of each of these. In 1872 he was created Honorary LL.D., of Edinburgh, and on June 21, 1876, he received the honorary degree of D.C.L. at Oxford.

In 1860 the Rumford Medal of the Royal Society was awarded to Professor Clerk Maxwell "for his Researches on the Composition of Colours, and other Optical papers." In his address on the presentation of the medal, Major-General Sabine alluded to Professor Maxwell's calculation showing the connection of the "mechanical strains to which elastic solids are subjected under certain conditions with the coloured curves which those solids exhibit in polarised light." He then alluded to the colour-top of Professor Maxwell, and the colour-equations obtained from it, as well as the light it throws upon colour-blindness, concluding with these words:—"These researches for which the Rumford medal is awarded lead to the remarkable result that to a very near degree of approximation all the colours of the spectrum, and therefore all colours in nature, which are only the mixtures of these, can be perfectly imitated by mixtures of three actually attainable colours, which are the red, green, and blue, belonging respectively to three particular points of the spectrum."

(To be continued.)

TELEGRAPHIC APPARATUS IN USE IN THE BRITISH POSTAL TELEGRAPH DEPARTMENT.*

I.

PREVIOUS to the transfer of the telegraph systems of the United Kingdom into the hands of the State, the apparatus in use was of various types and patterns; this arose from the fact that each telegraph company preferred to have instruments which they considered were best adapted for their own particular requirements. The transfer of the companies to the State necessarily involved a remodelling of the arrangements in existence, so that the system, as a whole, could work harmoniously. At first but few changes could be made, but as time went on, and extensions were erected, a gradual reduction in the diversity of the instruments was effected, so that, finally, a few distinct and uniform groups of apparatus were adopted for general use, together with a certain number of combinations of particular instruments which were necessary for particular purposes.

Very great improvements were effected when the old forms of instruments were remodelled, and at the present time the apparatus employed is in a highly efficient condition, and is well adapted for the purposes for which it was designed, though, of course, from time to time, further improvements are effected, such as experience and the ingenuity of the engineering staff are able to effect.

THE SINGLE NEEDLE INSTRUMENT.

The single needle instrument is practically merely a vertical galvanometer with keys, or pedals, for reversing the direction of the current through the same. In the form of instrument which is now but little used in the postal service, but which still finds favour with the railway companies, the reversing of the current was effected by means of a drop handle, which was worked from side to side by the hand which grasped it. These "drop handle" instruments, as they are called, were those originally employed by the "Electric and International" Telegraph Company, whose offices were, for the most part, at railway stations. The "Magnetic" Company, which was the second largest company in existence at the time of the transfer of the telegraphs to the State, worked very largely a form of instrument known as the "Bright's Bell," which will be described in a future article. The transmitting portion of this instrument consisted of two pedals, by which the battery current was sent in one direc-

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tion or the other. Now the taking over of the two companies, amongst others, by the State, and the large extensions to small country towns which resulted therefrom, necessitated the use of a large number of single needle instruments being brought into use, this form of instrument being easily worked and easily maintained, and as the clerks of the Magnetic Company under the new state of affairs were necessarily called upon, amongst their other duties, to work the instruments in question, it was considered advisable in all the new postal offices to adapt the "Bell" pedal or "tapper" key to the new single needle instruments, as the "Magnetic" clerks were accustomed to its use; this was accordingly done. At the railway offices, where the drop handle instruments were largely used, it was not considered advisable to make any alteration, as the clerks at those different offices were accustomed to their use, hence arises the fact that the "tapper" single needle is at present the form universally used in the postal offices, and the "drop handle" the form used in the railway offices.

"THE TAPPERS."

The design of an efficient form of "tapper" for reversing the current may appear to be a very simple matter, and theoretically no doubt it is so, but practically there are a very large number of points in connection with the design which are of importance if the working of the tapper is to be easy, certain, and also, as far as possible, noiseless. The easy motion of the tapper is a point by no means to be overlooked; nothing is so disagreeable as working an apparatus of the kind which gives a jar to the hand or fingers each time a tapper is depressed. The action must be certain, that is, it must not be liable to miss making contacts when being worked rapidly or with comparatively light pressure exerted on the tappers. Also the action should be, as far as possible, noiseless; the loud rattling of metal against metal in a small office where but few instruments are used is highly unpleasant, in a large office it would be intolerable.

The form of tappers now very largely adopted in the single needle instruments of the Postal Telegraph Department effects all the requirements in a very satisfactory way, and very rarely indeed gets out of order.

Fig. 1 shows a perspective view of the tappers as they appear removed from the case of the instrument of which they form a part. Fig. 2 is a plan of the same showing how the different parts are connected, together, and to the battery and needle dial.

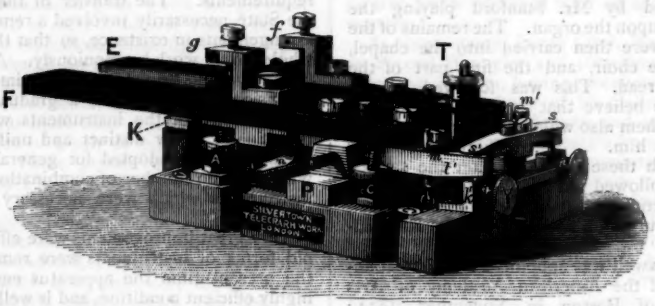


FIG. 1.

Each of the pedals, or tappers, E, F, is of ebony, and is hinged or pivotted to brass blocks, P, P, screwed firmly down on a teak base. The two blocks are insulated from each other by a piece of ebonite, *e*, shown on fig. 2 by the thick black line. The steel pivots which form the hinges run through brass blocks screwed firmly to the pedals. The screws which secure the brass blocks to the pedals have square brass washers under their heads, shown by the wide shaded lines; the screws can thus be screwed very firmly home, and this adds considerably to the strength of the pedals, whilst a solid and substantial hinge is formed which cannot easily be damaged or stick.

In the front part of the pedals, brass cocks *f* and *g* are firmly screwed, the screws passing through the wood and screwing into brass pieces underneath each pedal. Platinum-tipped screws are screwed on these cocks and make contact, when a pedal is depressed, with the ends of the spring *v*, *v'*, which are immediately beneath them. This spring is secured at its middle by two screws to a brass block screwed to the base of the apparatus, and its ends immediately beneath the platinum-tipped screws are themselves faced with platinum. The ends of this spring are slightly bent up, so as to be clear of the brass block to which it is secured.

The downward play of the pedals is limited by the felt-faced wooden block K, which is secured to the base of the apparatus. The platinum-tipped screws in the brass cocks, *f*, *g*, are screwed down sufficiently to enable contact to be made with the ends of the spring, *v*, *v'*, and for the latter to be depressed when the pedal banks fairly down, or nearly so, on the felt block. The play given to the ends of the spring, *v*, *v'*, ensures good contact being made.

To the back ends of the pedals are brass prolongations, *t*, *t'*, of the axle blocks; the projections are platinum-faced at the upper and lower parts of their ends. These lower platinum faces normally make contact with two brass blocks, *k*, *k'*, of which *k* is seen in fig. 1. The two blocks are kept connected together by means of a brass strap fixed by thumb screws, X, Y; the use of this strap will be explained hereafter. The pedals are held in their normal position by adjustable springs, *m*, *m'*, which can be tightened or loosened by unscrewing screws connected to them.

The play of the keys is of course finally limited by the height of the felt-faced block, K, also by the back blocks, *k*, *k'*, and, as regards actual regulation, by the screws passing though the cocks, *f*, *g*. These latter screws must be screwed down, so that when the pedals are well pressed down they make firm contact with the ends of the spring *v*, *v'*, it being seen at the same time that the projections, *t*, *t'*, at the back of the pedals make good contact and slightly raise the ends of the spring, *s*, *s'*.

The connections of the various parts of the key will best be seen by reference to fig. 2.

There are 4 terminals, Z, C, A, and T; the three former are marked by ivory labels, the latter has no distinguishing mark.

Terminal Z is connected by a brass strap with the brass block, *h*, to which the spring, *v*, *v'* is screwed.

Terminal C is connected to the block supporting the spring, *s*, *s'*.

Terminal T is connected with the hinge block of the left-hand pedal, and to the cock, *g*, on the right-hand pedal, by means of a brass strap running on the base of the apparatus. This strap passes under the right-hand pedal and is finally connected to the cock, *g*, by a curved brass spring, *n*, shown in fig. 2.

Terminal A is connected in a similar way to the foregoing, to the hinge block of the right-hand pedal, and to the cock, *f*, of the left-hand pedal.

Action of the tapper.

Supposing the left-hand pedal to be depressed, then the Zinc pole of the battery becomes connected to the block *h*, and thence by the end of the spring *v*, to the cock *f*, thence to terminal A and on to the "Up" line of the circuit. The Copper pole of the battery being in connection with the block supporting the spring, *s*, *s'*, becomes connected with the projecting piece *t*, and thence through the hinge block with terminal T, and from there through the dial of the instrument on to terminal B and the "Down" line.

If the right-hand pedal be depressed the zinc pole of the battery becomes connected with the cock, *g*, thence with terminal T, and through the dial with the "Down" line. The Copper pole C becomes connected through the end of the spring, *s'*, with the prolongation, *t'*, thence through the hinge block with terminal A and the "Up" line; thus the direction of the current is reversed.

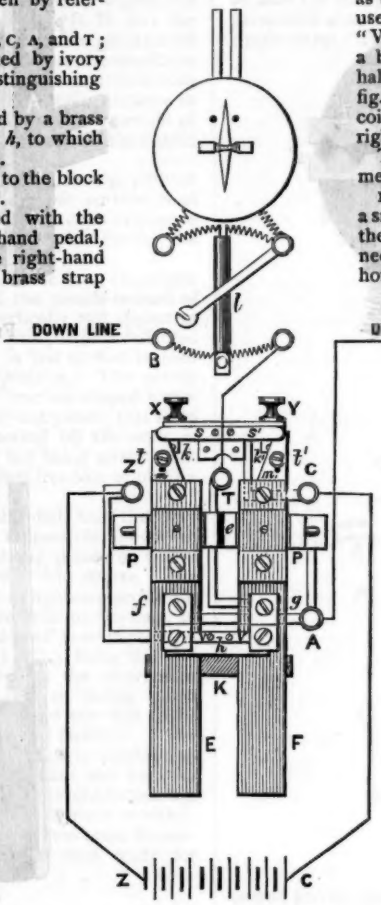


FIG. 2.

The connections shown are those for an "Intermediate" station. If the instrument is at an "Up" station, then the terminal A must be put to earth, terminal B being connected to line. If the instrument is at a "Down" station, the terminal A must be put to line, and terminal A to earth.

London is an "Up" station to all circuits in direct connection with it.

THE DIAL.

The "Dial" or "Single Needle Coil," as it is usually called, now in universal use in this country, is that known as "Varley's Induced Coil." Fig. 3 shows a back elevation complete; fig. 4 a half-side view with the coils removed; fig. 5 a side elevation of the left-hand coil, and fig. 6 a back elevation of the right-hand coil.

The construction of the arrangement is as follows:—

D, D, is a circular brass dial-plate, with a small hole in the centre through which the axis carrying the brass indicating needle in front of the dial and the thin horse-shoe soft iron needle, *h*, passes. The axle is pivotted in front of the dial to a brass bridge screwed to the dial; the inner end turns in a hole drilled in the screw, P; the latter screws into the centre of the brass plate, A, A, which is secured to a similar brass plate, B, B, by the round brass rods seen in fig. 4, so that the whole forms a frame. The dial, D, D, is secured to the brass plate, B, B, in the following manner:—A round but conical-shaped hole is formed in B, B; a round piece of brass *b*, also conical-shaped, fits in this hole so that it can turn in it stiffly, but not pass through it. This round brass piece is screwed to the dial-plate, D, D, by two screws, the whole arrangement, therefore, is such that D, D, can be turned round to any angle if required; this is necessary in order that the front needle may be made to stand always equidistant between the two ivory stops when it is working. If the position of the needle were always vertical, there would be no necessity for the dial-plate being made movable, but it often happens that an earth current will for a time give the needle a permanent list over to one side of the dial or the other, so that working would become impossible if the provision to get over this difficulty was not made by enabling the dial to be turned round to the necessary angle.

The inducing coils C, C′, are shown in position in fig. 3; they are secured to the frame in slots, *s*, *s*′ by means of thumb-screws, *t*, *t*′; the right-hand coil is

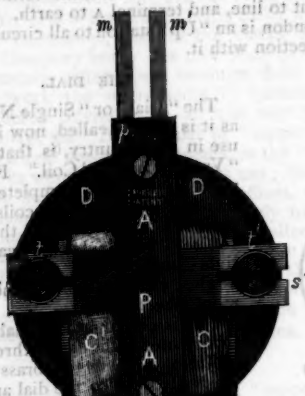


FIG. 3.

into each of them is let a piece of soft iron, shown by *i*, fig. 5; this piece of iron is flush with, in fact, forms a part of, the brass cheeks of the coils. A

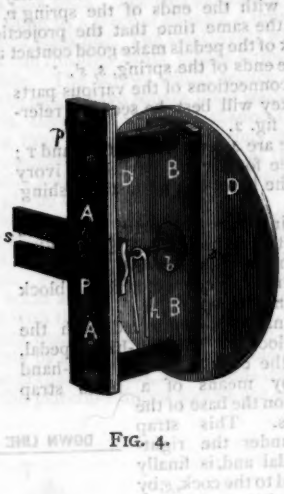


FIG. 4.

FIG. 5.

FIG. 6.

drawn with its silk protecting covering removed, to show the wire wound on it.

Fig. 6 shows a back view of the right-hand coil which is removed from the frame. Fig. 5 shows a side view of the left-hand coil. The frames of these coils on which the wire is wound are of brass; but

small channel, *c*, is filed in each inner coil cheek face, and in this the axis of the needle is enclosed when the coils are fixed in position.

m, *m*′ are two steel permanent magnets which are screwed to the iron portion of the coil cheeks; these magnets act by induction on the soft iron pieces,

and render the ends of the latter, which abut on the channels, *c*, *c*, of the coils, highly magnetic, consequently when the coils are in position, the horseshoe needle, *h*, fig. 4, becomes also magnetised powerfully by induction, as its upper part is in close proximity to this magnetic pole.

The inner ends of the wire wound on the coils are soldered to the insides of the frames so that when the two coils are in position they are electrically connected through the metal work of the frame.

The wire on the coils which is found to give the most satisfactory results is No. 35, B. W. G.; the quantity wound on the two coils together gives a total resistance, of about 200 ohms, whilst the sensitiveness of the arrangement is such that a current from 1 Daniell cell flowing through a total resistance in the circuit of 3000 ohms., that is to say, a current of $\frac{1}{3000}$ webers, or $\frac{1}{3}$ milliwebers, will deflect the needle up to the ivory stops.

The needle in front of the dial, as was pointed out before, is of brass, but the upper portion is of thicker metal than the lower, so as to counterbalance the weight of the soft iron needle inside the coils.

The good pivotting of the axle is an important point, for if this is not good the needle instead of moving freely and hanging vertically will appear to move stiffly and will tend to remain partially deflected over on the side to which it is last moved, instead of returning to its normal position. The pivots which are found to answer best are shaped somewhat like the end of a newly-cut pencil, that is to say, they are formed by tapering off the ends of the axle to a point, the taper not being straight but concave. This form gives great freedom of motion to the needles.

A general front view of the dial, and the way it is connected up to the tappers, is shown in fig. 2. In this fig., *l* is a lightning protector, whose construction will be explained in due course. The four terminals to which the dial, lightning protector, and tappers are connected, are fixed to the back of the instrument case. The dial itself is set in position by the brass plate, A, A, figs. 3 and 4, being slid into a grooved brass piece secured to the instrument case, the pin *p* preventing it from sliding down too far; this arrangement enables the dial to be removed when required with great facility.

The tappers and dial being fixed in position in their respective places on the base and back of the instrument case, and the wires connected up, the front part of the case, which is made movable, is put in its place and secured by two brass thumbscrews; the whole instrument is then ready for use.

SLATER'S IMPROVED BATTERY.

THE commercial value of certain salts is largely in excess of the value of the amount of metal and acid from which they may be produced; this is notably the case with certain salts of nickel, whose value, weight for weight, is about equal to that of the metal from which they are manufactured; but inasmuch as a pound of nickel, by combination with an acid, can produce an amount of salt equal to about six times the weight of metal consumed, it follows that, if the salt can be produced easily, and the acid from which the salt formed be very cheap, that a considerable margin of profit will remain to repay the manufacturer of such salts.

The use of zinc for the positive electrode in galvanic batteries has been almost universal; and although it was well known that other metals could be used for the purpose, their high price, as compared with zinc, has hitherto entirely precluded their employment. The dissolution of zinc in a battery, as

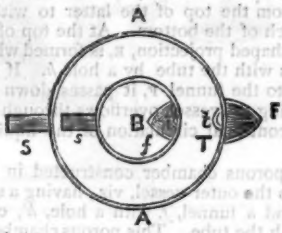


FIG. 1.

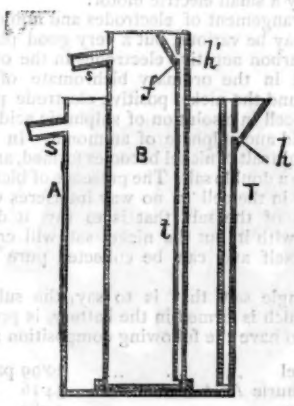


FIG. 2.

is well known, produces salts of that metal which are of but little, if any, commercial value, consequently these salts are regarded entirely as waste products, and are thrown away when the battery is cleaned out. The action of an ordinary battery is, therefore, not such as to produce a product, as far as the consumption of the zinc is concerned, which will repay its consumption irrespective of the electricity generated; nor are the other products produced in the battery of a comparative commercial value. If, however, instead of zinc, some metal be employed, the consumption of which will produce salts of a value greatly exceeding that of

the metal and acid consumed, then it must be evident that such an arrangement will be highly advantageous, as not only is there a profit to be made from the sale of the salt, but we have electricity produced, which is also a saleable commodity. Mr. Thomas Slater has had these facts in view amongst others in inventing an improved form of battery. His invention consists in employing a nickel electrode in the place of the usual zinc plate, and in forming the cells of which the battery is composed in such a manner that the liquids can be kept constantly in motion, and polarisation thus be prevented. The form of cell adopted is shown in plan and section by figs. 1 and 2 respectively. A is a glazed porcelain jar provided with a small spout, S, at its upper part. A tube, T, formed on the vessel, reaches from the top of the latter to within about half an inch of the bottom. At the top of the tube a funnel-shaped projection, E, is formed which communicates with the tube by a hole *h*. If liquid be poured into the funnel F, it passes down the tube T, and filling the vessel, overflows through the spout S, thus a continual circulation of the liquid can be kept up.

B is a porous chamber constructed in a similar manner to the outer vessel, viz., having a spout, *s*, a tube, *t*, and a funnel, *f*, with a hole, *h'*, communicating with the tube. This porous chamber is kept in the centre of the outer chamber by a recess in the bottom of the latter. The circulation of the liquids in the cells is easily kept up by a pump worked by a small electric motor.

The arrangement of electrodes and liquids in the battery may be various, but a very good plan is to employ carbon negative electrodes in the outer cell immersed in the ordinary bichromate of potash solution, and the nickel positive electrode placed in the inner cell in a solution of sulphuric acid or sulphuric acid and sulphate of ammonia. In the one case a single salt of nickel becomes formed, and in the other case a double salt. The presence of bichromate of potash in the cell in no way interferes with the formation of the salt, that is to say, it does not combine with it, but the nickel salt will crystallise out by itself and can be collected pure without difficulty.

The single salt, that is to say, the sulphate of nickel, which is formed in the battery, is proved by analysis to have the following composition :—

Nickel	20·99	parts.
Sulphuric Acid	34·16	„
Water	44·80	„
Waste	·05	„
	100·00	

This agrees very closely with theory, according to which the amount of nickel should be 20·71.

When the fluids in the battery are such as to cause the double salt to be formed, then the latter is found to have the following composition :—

Nickel	14·91	parts.
Sulphuric Acid	24·30	„
Sulphate of Ammonia ...	33·42	„
Water	27·34	„
Waste	·03	„
	100·00	

According to theory the amount of nickel should be 14·72.

The principal use of the nickel salts is for electroplating purposes, and great quantities are consumed for the purpose. Both the single and double salt of nickel referred to answers well for electroplating, but a solution, which Mr. Slater considers superior to the foregoing for plating purposes, may be obtained by charging the battery with a solution of common salt, this causes a double salt of chloride of nickel and sodium to be formed. The power of the battery when bichromate of potash is used as the negative excitant, and sulphuric or nitric acid, or sulphuric acid and sulphate of ammonia as the positive excitant, is about equal to a Bunsen. We have only to add that the commercial value of nickel is about 4s. per lb., and of the salts of nickel referred to, 3s. 6d. per lb. (these are quoted prices from the manufacturer), and the commercial value of the arrangement is obvious; for, taking the analysis given of the single salt of nickel, we have roughly—

21 lbs. of Nickel, at 4s. per lb.	£4	4	0
34 „ Sulphuric Acid, at 1½d. per lb.	0	4	3
45 „ Water	0	0	0
100	£4	8	3

There is thus produced 100 lbs. of sulphate of nickel, which, at 3s. 6d. per lb., gives £17 10s., besides the electric power generated. From this estimate, of course, deductions must be made for cost of plant, labour, waste, &c.; but, allowing for this, Mr. Slater's invention seems likely to be a highly profitable one when used for electric lighting, for motive power, or for plating purposes, &c., even supposing (as would be the case) the commercial value of the products decreased considerably.

This battery is to be seen at work at No. 97, Cheapside.

GRAMME'S ALTERNATING CURRENT DYNAMO-ELECTRIC MACHINE.

THE employment of alternating currents for producing the electric light is now very general, and the production of these currents has hitherto been almost invariably attained by means of two dynamo machines working quite independently; the one machine called the "excitor," producing continuous currents which excite the inducing electro-magnets of the second machine, from which the alternate currents are generated. M. Gramme has devised a form of alternating current apparatus in which both the excitor and generator are driven on one axle, thus forming a very compact and highly efficient arrangement. The new form of machine is shown by the figs.—fig. 1 being a sectional front elevation of the whole apparatus; fig. 2, a sectional elevation of the excitor coils; and fig. 3 a similar view of the generator coils. The position of the collecting "brushes" is shown in figs. 2 and 3.

The action of the excitor is to produce a continuous current as in the ordinary Gramme machine. This current passes through the revolving bobbins of the generator, thereby inducing alternate permanent polarity in their poles; the coils in front of these revolving alternate poles have alternate

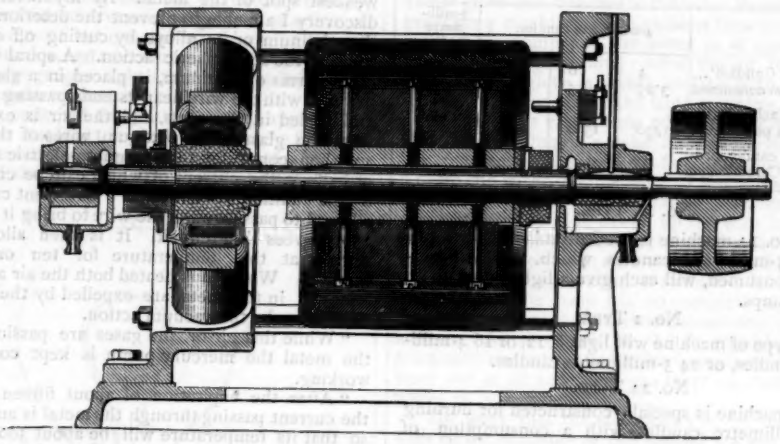


FIG. 1.

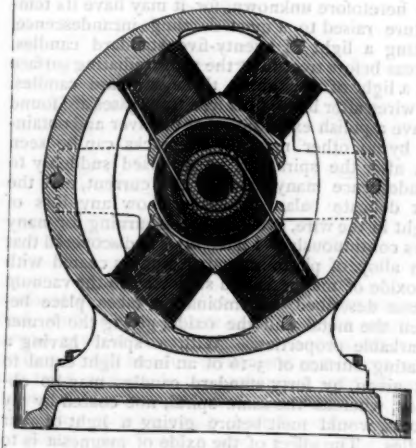


FIG. 2.

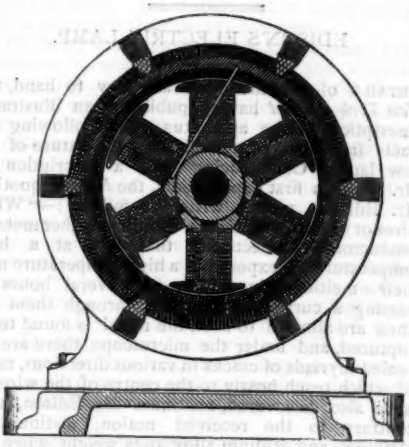


FIG. 3.

currents induced in them which pass out to the lamps.

Four types of the machine are at present manufactured, viz. :

No. 1 TYPE.

	4-millimetre candles.			3-millimetre candles.
Number of Candles ...	4	6	8	12
Horse power consumed	3·25	4·5	6	—
Speed of Machine in revolutions per minute	1250	1300	1450	1460 to 1500
Light per candle produced, in Carcel lamps	70	60	50	30

No. 1A TYPE.

The No. 1A machine is specially adapted for lighting 12 3-millimetre candles, which, with 4 horse-power consumed, will each give a light equal to 30 Carcel lamps.

No. 2 TYPE.

This type of machine will light 8, 12, or 16 4-millimetre candles, or 24 3-millimetre candles.

No. 2A TYPE.

This machine is specially constructed for burning 24 3-millimetre candles with a consumption of 8 horse-power.

The cost of the candles with 3-millimetre carbons is 4d. The circuits of No. 1 machine, when it is required for burning 4, 6, or 8 lights, are grouped for quantity, as this gives the best effect. If the 12 lights are used then the circuits are joined up in series. In the case of 8 large or 12 small lights a resistance is introduced between the two parts of the machine.

EDISON'S ELECTRIC LAMP.

DETAILS of this invention are now to hand, the *New York Herald* having published an illustrated description of the apparatus. The following extracts from that paper will show the nature of the new lamp. Commencing with a description of Mr. Edison's first experiments, the *Herald*, quoting Mr. Edison's words, writes as follows :—"When wires or sheets of platinum, iridium or other metallic conductors of electricity that fuse at a high temperature are exposed to a high temperature near their melting-point in air for several hours by passing a current of electricity through them and then are allowed to cool, the metal is found to be ruptured, and under the microscope there are revealed myriads of cracks in various directions, many of which reach nearly to the centre of the wire. I have also discovered, continues Mr. Edison, that, contrary to the received notion, platinum or platinum and iridium alloy loses weight when exposed to the heat of a candle ; that even heated air causes it to lose weight ; that the loss is so great that a hydrogen flame is tinged green. After a time the metal falls to pieces ; hence wire or sheets of platinum or platinum and iridium alloy as now known in commerce are useless for giving light by incandescence—

"1st. Because the loss of weight makes it expensive and unreliable, and causes the burner to be rapidly destroyed.

"2nd. Because its electrical resistance changes by loss in weight, and its light-giving power for the total surface is greatly reduced by the cracks or ruptures.

"The melting-point also is determined by the weakest spot of the metal. By my invention or discovery I am able to prevent the deterioration of the platinum or its alloys by cutting off or intercepting the atmospheric action. A spiral wire, or other forms of platinum, is placed in a glass tube or bulb, with the wire near its ends passing through and sealed in the glass, and the air is exhausted from the glass. The platinum wires of the spiral are then connected to a magneto-electric machine or battery, the current of which can be controlled by the addition of resistance. Sufficient current is allowed to pass through the wire to bring it to about 150 degrees Fahrenheit. It is then allowed to remain at this temperature for ten or fifteen minutes. While thus heated both the air and gases confined in the metal are expelled by the heat or withdrawn by the vacuum action.

"While this air or the gases are passing out of the metal the mercury pump is kept continually working.

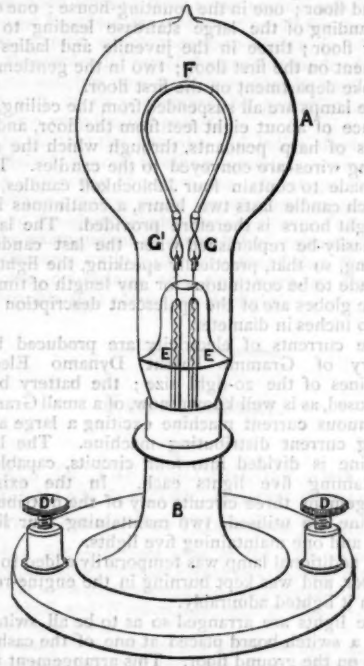
"After the expiration of about fifteen minutes the current passing through the metal is augmented so that its temperature will be about 300 degrees Fahrenheit, and it is allowed to remain at this temperature for another ten or fifteen minutes.

"The mercury pump is to be worked continuously and the temperature of the spiral raised at intervals of ten or fifteen minutes until it attains vivid incandescence and the glass is contracted where it has passed to the pump and melted together.

"The wire is now in a perfect vacuum and in a state heretofore unknown, for it may have its temperature raised to a most dazzling incandescence, emitting a light of twenty-five standard candles, whereas before treatment the same radiating surface gave a light of only about three standard candles. The wires after being thus free from gases are found to have a polish exceeding that of silver and obtainable by no other means. No cracks can be seen even after the spiral has been raised suddenly to incandescence many times by the current, and the most delicate balance fails to show any loss of weight in the wire, even after it is burning for many hours continuously. I have further discovered that if an alloy of platinum and iridium is coated with the oxide of magnesia and subjected to the vacuum process described, a combination takes place between the metal and the oxide, giving the former remarkable properties. With a spiral having a radiating surface of 3-16 of an inch light equal to that given by forty standard candles may be obtained, whereas the same spiral, not coated by my process, would melt before giving a light of four candles. The effect of the oxide of magnesia is to harden the wire to a surprising extent and render it more refractory. A spiral made of this wire is elastic and springy when at high incandescence. I have found that chemically pure iron and nickel drawn in wires and subjected to the vacuum process may be made to give a light equalling that of platinum in the open air. Carbon sticks also may be freed from air in this manner, and be brought to a temperature where the carbon becomes pasty, and on cooling it is homogeneous and hard."

About this time another truth dawned upon the inventor, namely, that economy in the production of light from incandescence demanded that the incandescent substance should offer a very great resistance to the passage of the electric current. Concerning this the inventor writes:—"It is essential to reverse the present practice of having lamps of but one or two ohms (electrical units) resistance, and to construct lamps which when giving their proper light shall have at least two hundred ohms resistance."

Having perfected the platinum lamp apparently, Mr. Edison was lead to try, "by accident," a filament of compressed lampblack and tar, heated by the passage of the electric current, and the result was



satisfactory. A piece of carbonised cotton was next tried, with better results still: a light equal to several gas-jets being obtained. Several other experiments with various carbonised substances were then tried, and finally the carbonised strip of cardboard was found to give the best results.

"With a suitable punch there is cut from a piece of 'Bristol' cardboard a strip of the same in the form of a miniature horse-shoe, about two inches in length and one-eighth of an inch in width. A number of these strips are laid flatwise in a wrought iron mould about the size of the hand, and separated from each other by tissue paper. The mould is then covered and placed in an oven, where it is gradually raised to a temperature of about six hundred degrees Fahrenheit. This allows the volatile portions of the paper to pass away. The mould is then placed in a furnace and heated almost to a white heat, and then removed and allowed to cool gradually. On opening the mould the charred remains of the little horse-shoe cardboard are found. It must be taken out with the greatest care, else it will fall to pieces. After being removed from the mould it is placed in a little globe and attached to the wires leading to the generating machine. The globe is then connected with an air pump, and the latter is at once set to work extracting the air. After the air has been extracted the globe is sealed, and the lamp is ready for use. The fig. shows the lamp complete.

"A is a glass globe, from which the air has been abstracted, resting on a stand, B. F is the little carbon filament connected by fine platinum wires, G G¹, to the wires, E E¹, leading to the screw posts, D D¹, and thence to the generating machine. The current, entering at D, passes up the wire E to the platinum clamp, G; thence through the carbon filament F to G¹, down the wire E¹ to the screw post D¹; thence to the generating machine. It will be noticed, that the lamp has no complex regulating apparatus, such as characterised the inventor's earlier labours. All the work he did in regulators was practically wasted, for he has lately realised that they were not at all necessary—no more so than a fifth wheel is to a coach.

"He finds that the electricity can be regulated with entire reliability at the central station, just as the pressure of gas is now regulated. By his system of connecting the wires the extinguishment of certain of the burners affects the others no more than the extinguishment of the same number of gas burners affects those drawing the supply from the same mains. The simplicity of the completed lamp seems certainly to have arrived at the highest point, and Edison asserts that it is scarcely possible to simplify it more. The entire cost of constructing them is not more than twenty-five cents.

"The lamp shown in the fig. is a table lamp. For chandeliers it would consist of only the vacuum globe and the carbon filament attached to the chandelier, and connected to the wires leading to the generating machine in a central station perhaps a half-mile away, the wires being run through the gas pipes, so that in reality the only change necessary to turn a gas-jet into an electric lamp is to run the wires through the gas pipe, take off the jet, and screw the electric lamp in the latter's place. Although the plans have been fully consummated for general illumination, the outline of the probable system to be adopted is the locating of a central station in large cities in such a manner that each station will supply an area of about one-third of a mile. In each station there will be, it is contemplated, one or two engines of immense power, which will drive several generating machines, each generating machine supplying about fifty lamps.

"The apparatus for measuring the amount of electricity used by each householder is a simple contrivance consisting of an electrolytic cell and a small coil of wire, appropriately arranged in a box, the latter being of about half the size of an ordinary gas meter, and like a gas meter it can be placed in any part of the house. The measurement is obtained by the deposit of copper particles on a little plate in the electrolytic cell, such deposit being caused by the electric current passing through the cell. At the end of any period, say one month, the plate is

taken by the inspector to the central office, where the copper deposit is weighed, and the amount of electricity consumed determined by a simple calculation."

The Comte du Moncel has addressed a letter on the subject of Mr. Edison's invention to Dr. Cornelius Herz which was published in *Le Temps*. The Comte expresses astonishment at the excitement caused in the money market by the praises bestowed on the lamp, which is called, "A great discovery." "Edison," says the writer, "is an ingenious and fertile inventor, but is not acquainted with the discoveries made before his time. Neither the idea of the telephone nor the realisation of the phonograph belongs to Edison. His first lamp was a modification of the one invented by Changy in 1858. The one now announced is the modification of those of several inventors. In 1875 much noise was made about the incandescent carbon lamp of Korloff, the pretension being that one Alliance machine could feed fifteen lamps, and yet no more than two have ever been seen working. Regnier and Werdermann, by adding the voltaic arc to that combination, obtained better results. The new Edison lamp revives the Lodiguyne lamp in a different shape. The small carbon needles are replaced by laminated carbon, or carbonised Bristol paper separated by metallic tissues carved into the form of a horse-shoe, and joined to the circuit by platinum wires, the whole being in a vacuum, as in Lodiguyne's system. That arrangement may be better than anything previously devised, but it is not an invention of the importance assigned to it by the American papers. The idea of intercalating metallic bodies in the carbonised mass is not new, for it had been realised by Jablochkoff and Kelmer. It is difficult for the carbon horse-shoe, so loose and delicate, not to be deteriorated by prolonged incandescence, on account of the caloric action disintegrating the carbonic particles and by the mechanical action of the current which carries them away and deposits them on the sides of the recipient, as in Geissler's tubes. The metallic tissues separating the layers of carbon would be damaged. Experience alone will be able to decide, and it is prudent to wait, in spite of the announcement of fifty or sixty foci fed from a single machine. The same may be said of the dynamo-electric machine which offers nothing new about which the theories put forth would upset the laws of Ohm and Joule, theories which are at variance with the experiments made with every other machine. Edison has given no account of the maximum effects." The writer finally protests against the *sans façon* of the Americans with regard to European inventions. "For them electrical science, which sprang up yesterday, was discovered in America. Many examples might be cited, to which the name of Mr. Prescott is not foreign, but we prefer to say no more. Let the public be on their guard against the pompous announcements which reach us from the New World."

ERRATUM.—At the end of the article on the "Brush" Electric Light system, which appeared in our last issue, "2,000" candles were, by a printer's error, given as "20,000."

THE ELECTRIC LIGHT AT LUDGATE HILL.

THE premises of Messrs. Samuel Brothers, Merchant Tailors, of Ludgate Hill, London, have been fitted up with the electric light, and the inauguration of the lighting took place on Wednesday evening, the 14th inst., in the presence of a large number of gentlemen interested in the question of electric lighting, representatives of the press, &c., &c.

They are lighted by means of thirteen electric lamps of the Jablochkoff system, and which are distributed as follows :—

One in each of the two windows on each side of the principal entrance in Ludgate Hill; two in the front of the ground floor; two in the back of the ground floor; one in the counting-house; one over the landing of the large staircase leading to the upper floor; three in the juvenile and ladies' department on the first floor; two in the gentlemen's bespoke department on the first floor.

The lamps are all suspended from the ceiling, at a distance of about eight feet from the floor, and by means of harp pendants, through which the conducting wires are conveyed to the candles. They are made to contain four Jablochkoff candles, and as each candle lasts two hours, a continuous light for eight hours is therefore provided. The lamps can easily be replenished when the last candle is burning, so that, practically speaking, the light can be made to be continuous for any length of time.

The globes are of the opalescent description and are 20 inches in diameter.

The currents of electricity are produced by a battery of Gramme Patent Dynamo Electric Machines of the 20-light size; the battery being composed, as is well known now, of a small Gramme continuous current machine exciting a large alternating current distributing machine. The large machine is divided into four circuits, capable of maintaining five lights each. In the existing arrangement three circuits only of the distributing machine are utilised, two maintaining four lights each, and one maintaining five lights.

An additional lamp was temporarily added to that number, and was kept burning in the engine-room, which it lighted admirably.

The lights are arranged so as to be all switched from a switch board placed at one of the cashier's desks on the ground floor. This arrangement is an important feature, and the switching was shown in operation.

The motive power for working the electric machines is obtained from a 12 horse-power "Otto" gas engine, made by Messrs. Crossley Brothers, of Queen Victoria Street, London.

It is within the mark to say that this form of engine is taking the place of steam at the rate of twenty-five engines a week, a fact that should go a long way to re-assure holders of gas-stock.

The Gramme machines are driven directly by means of suitable pulleys fixed on the shaft of the engine, the small one, or excitor, running at a speed of 612 revolutions, and the large one, or distributor, at a speed of 688 revolutions per minute. They are together with the gas engine erected in a room situated in the basement at the back of the building.

The whole mechanical and electric plant, which has been fitted up under the immediate super-

vision of M. J. A. Berly, C.E., the Engineer to the Société Générale d'Electricité, is erected in a most substantial manner.

At an experiment made by M. Berly, and Mr. Wilson, C.E., the London representative of the firm of Messrs. Crossley Brothers, twenty lights were maintained by the gas engine, and there is no doubt that a larger number could be maintained after the plant has been in operation during a certain period, as the stiffness with which all new machines work will gradually disappear and the producing qualities of the Gramme machines will gradually improve.

This is the first time, in this country as well as in France, that a large number of Jablochkoff lights have been worked from a gas engine, and Messrs. Samuel Brothers deserve great credit for the enterprising spirit which they have shown, in adopting for their splendid establishment this mode of illumination which is now steadily making its way ahead, and will, in all probability, be generally adopted within a very limited period.

On visiting the bespoke and ladies' department of Messrs. Samuel Brothers' premises, we could at once appreciate the immense advantage that the purchasing public would derive from the introduction of the electric light.

On examination of some ladies' costume cloths, gentlemen's suitings, &c., we found that the most delicate colourings and tints were as distinctly discernible as if viewed by daylight.

Correspondence.

TRIALS OF THE JABLOCHKOFF AND WERDERMANN ELECTRIC LIGHTS IN PARIS.

To the Editor of THE TELEGRAPHIC JOURNAL.

DEAR SIR,—In your issue of the 15th ultimo you publish an extract from the French newspaper *L'Estafette*, in which some particulars of the competitive trial of the Jablochkoff and Werdermann lights at the "Foyer de l'Opera" are given.

As many of the statements published by *L'Estafette* are erroneous, I shall feel very much obliged if you would kindly publish the enclosed letter, which was addressed by the chairman of the Soc. Gen. d'Electricité to the journal *L'Estafette*, and published by the latter in its issue of the 28th November, 1879.

Yours faithfully,
J. A. BERLY, C.E.,
Engineer to the Soc. Gen. d'Electricité.

Extract from the Journal *L'Estafette*, November 28, 1879.

"We have received the following letter:—

"To the Editor of *L'Estafette*.

"Sir,—We have read in your issue for November 22nd an article on some experiments made yesterday at the *foyer* of the Opera House, an article which contains such serious errors that we are compelled to reply to it.

"If the editor of the article in question had really attended the experiments of which he writes he would not have seen in the room MM. Turguet, Herold, and Alphand, who were *not* present at the experiments, and he would have seen that the *two chandeliers supplied with gas by the Parisian Company* were not lighted.

"We had no wish to point out that the experiments of the Werdermann Society had been favoured by the obliging co-operation which our Society had offered, in putting at their disposal its motor and its workmen. We ask simply in exchange for impartiality.

"The text of the article obliges us to relate the facts of the case.

"It is said that '*the Jablochkoff lamps made their appearance before those of Werdermann, because the Jablochkoff Company delayed in getting ready the steam engine which should have been lent to the Werdermann Company.*'

"This fact is erroneous; the engine in question had been since the 22nd October at the entire disposal of M. Napoli, engineer-in-chief to the Werdermann Company. In spite of this the experiments had to be made at two different times as the Werdermann apparatus was not ready.

"The globes of yellow glass were only placed upon a formal demand being made; they proved, in every case, capable of giving the required tint to the light. In spite of the reduction which they produced upon the eight Jablochkoff lights, the total light produced was incontestably superior to that of the twelve Werdermann lights.

"The hissing noise, who heard it?

"As to the power absorbed by the twelve Werdermann lights, we can say what this was better than any one, inasmuch as we lent the engine which produced the light. This engine was driven at such a high velocity and at such a pressure of steam that the funnel became red-hot along a great portion of its length, necessitating important repairs. The Jablochkoff lamps, driven by the machine which serves ordinarily for the lights placed on the Place de l'Opéra, consumed 8 horse-power, and gave a total intensity superior to that of the twelve Werdermann lamps, which absorbed, thanks to the manner in which the motor had been driven, as much power, if not more.

"As to the differences of velocity of the Gramme machines, they existed in effect, but in the reverse sense to that attributed.

"As to the respective qualities of the two lights, it would appear useless to refer to them. We leave this for the public to judge.

"Trusting that you will have the kindness to allow these corrections to appear in your columns,

"We remain, Sir, etc.,
"A. DE SOURDEVAL,
"President of the Council."

ADELAIDE, S.A.—Lines running east and west are rather more subject to earth current disturbances than those running north and south, but no inconvenience worth speaking of arises from this fact. In England, at least, no difficulty whatever is found in working lines running east and west as compared with those running north and south.—ED. TEL. JOUR.

IT is stated that the German Postmaster-General is preparing a proposal to be presented to the Reichstag, under which the post-office department will have charge of the entire freight traffic of the German railways, and will become the general carrier for the German public.

Notes.

EDISON'S NEW ELECTRIC LAMP.—A strip of cardboard bent into a horse-shoe form and converted into carbon by baking in an iron mould, is the basis of the new lamp; the strip is placed in an exhausted globe, and a current of electricity being sent through the strip renders the latter incandescent. As regards durability, &c., the *Times* correspondent says:—"About 60 lights were burning. On Saturday night I saw them burn seven hours. Two have been burning continuously for ten days without injury to the baked cardboard horse-shoe in the little glass globe which furnishes the light. Cardboard seems sufficiently durable, successfully resisting quite rough usage, such as dropping, shaking, turning the current on and off thousands of times, and raising the intensity of light to that of 400 candles. All the arrangements are simple. Mr. Edison will put about 800 lights at Menlo Park, while the inventions immediately go into practical operation in New York city. The globe containing the horse-shoe is exhausted to one-millionth of an atmosphere by the Sprengel pump, measured by the M'Leod gauge. By successfully dividing the electric current Mr. Edison gets individual lamps of 16-candle power, each lamp having 100 ohms resistance. Light is turned on or off and the current regulated with the same ease as gas is, while the current can be transmitted on wire as small as No. 36. The central regulator maintains an even current, while the meters accurately measure the supply furnished to each consumer. Mr. Edison finds that the best generators are of five to seven horse-power, each one horse-power maintaining eight lamps. Each lamp costs about one shilling to manufacture, while a supply equivalent to 10,000ft. of gas can be produced for tenpence or less. Mr. Edison calculates the cost of furnishing light thus—the consumption of 3lb. of coal in a steam engine will maintain eight to ten lamps one hour. Mr. Edison's system also furnishes electric power for small industries, such as running sewing machines. Mr. Edison's light is bright, clear, mellow, regular, free from flickering or pulsations, while the observer gets more satisfaction from it than from gas. Mr. Edison lights at Menlo Park, dwellings, offices, desks, street lamps, also laboratory and workshop, making it available for every lighting purpose for which gas is used."

THE telegram which announced Mr. Edison's invention created great excitement, and we think it a matter for regret that such an influential journal as the *Times* should publish such sensational announcements, which, although they will be taken for what they are worth by all scientific men, yet tend to mislead the general public. We may mention that Mr. J. W. Swan, writing to *Nature*, says, "Fifteen years ago I used charred paper and card in the construction of an electric lamp on the incandescent principle. I used it, too, of the shape of a horse-shoe, precisely as, you say, Mr. Edison is now using it. I did not then succeed in obtaining the durability which I was in search of, but I have since made many experiments on the subject, and within the last six months I have, I believe, completely conquered the difficulty which led to previous failure, and I am now able to produce a perfectly durable electric lamp by means of incandescent carbon."

Apropos of Mr. Edison's so-called discovery, we commend to the notice of our readers an excellent article on "The Great Edison Scare," which appeared in the number of the *Saturday Review* for Jan. 10th.

IN the last presidential address to the Royal Society, Mr. Spottiswoode mentioned, that "The electric light has been recently effectively employed in surveying and sounding the Mediterranean by night, and in the operation of laying and repairing cables by the s.s. *Dacia*, belonging to the Silvertown company. By its aid 96 soundings, made with Sir William Thomson's steel wire apparatus, in water averaging 1,500 fathoms depth, were taken in seven days and nights, bottom in every case being brought up."

ELECTROLYTIC EXPERIMENTS.—Some remarkable electrolytic experiments have recently been made by Herr Dreschsel. Instead of employing a continuous current to effect decompositions, Herr Dreschsel submits the substance under test to a series of rapidly reversed currents. The first experiment was made with a solution of carbonate of ammonia, using platina electrodes. After about eight hours' duration of the experiment, the liquid was evaporated in the water-bath, and a salt crystallised out, in beautiful white needles. This proved to be a salt of a platinum base. As a controlling experiment, a solution of the ammonia salt referred to was afterwards submitted to the ordinary kind of electrolysis; and it was found that the liquid then contained no dissolved platina. It appeared that with a slow reversal of the current no precipitate was separated, unless the liquid be simultaneously cooled; under these circumstances there is an abundant crystalline precipitate, which likewise presents a salt of a platina base, but contains less platina than the first-described combination. When a grape-sugar solution, with phosphate of soda added, was electrolysed by means of very large platina electrodes, which were kept from contact by means of a disc of blotting-paper, the platina was found, at the end of the experiment, in the places where the paper was applied, covered with a brownish, transparent coat, easily removed in large lamellæ, which, on combustion, left behind considerable quantities of platina.

THE SCOTTISH TELEPHONIC EXCHANGE.—A Telephonic Exchange has been formed in Scotland having centres at Edinburgh, Glasgow, and Dundee. The Company will place in the office, warehouse, or residence of each member the requisite instruments and appliances, connecting the same by means of a wire with the central office, and maintaining them in working order at a rental varying from £10 to £20 per annum, according to the facilities required. Mr. J. G. Lorrain, C.E., is the general manager of the Company.

BRAZILIAN TELEGRAPHS.—"The Government lines in Brazil work in a very efficient manner; since the 1st of January there have been only 28 interruptions, principally short ones, the longest having lasted but 3 days. The same good fortune has not attended the Western and Brazilian Company's coast cable, which has, during the same period, been subjected to 4 interruptions, extending over an interval of 93 days, the shortest stoppage having lasted 7 days. The Government land lines forwarded all the messages which were refused by the Cable Company owing to the suspension of their traffic. The Government tariff for a message from Recife to Rio Janeiro is one franc, whilst the Cable Company charge five francs. From Recife to all points of the empire south of Rio Janeiro the Government charge is two francs per word."

AUSTRIAN TELEGRAPHS.—According to the report issued by the Ministry of Trade the present system of telegraphs in Austria consists of 23,069 miles of line, containing 58,919 miles of wire. This quantity includes 15,140 miles Government line, 7,650 miles railway lines, and 277 miles of private lines. There are 2,484 stations, of which 1,088 are Government,

1,301 railway, and 95 private. In the Government offices 1,772 Morse, 52 Hughes, 5 Meyer's multiplex instruments, and one d'Arlincourt translator are in use. The total number of messages despatched was 5,087,568, the inland messages amounting to 3,563,294, the total showing an increase of 2·7 per cent. over the preceding year.

NOTICE has been given in the *Canada Gazette* that application will be made at the next session of the Parliament of the Dominion of Canada for an act to "incorporate the French Atlantic Cable Company," and to create the Compagnie Française du Télégraphe de Paris of New York, and create the shareholders in said company a corporation within the Dominion of Canada under the name of "The French Atlantic Cable Company."

THE NEW ZEALAND TELEGRAPH DEPARTMENT.—The fifteenth annual report of the New Zealand Telegraph Department states that the revenue for the year ending 30th June, 1879, was estimated at £76,000, but it has exceeded that amount by £5,435 14s. 4d. Omitting the value of Government telegrams, which amounts to £26,926 13s. 7d., the gross earnings of the department, including subsidies for special wires, incidental receipts, and sundry recoveries show the total receipts for the year to have been £85,402 0s. 2d. Adding to this the value of Government messages, the total value of business performed by the department amounts to £112,328 13s. 9d. The total number of messages of all codes transmitted during the year was 1,448,943, being an increase over the previous year of 188,619, or nearly 14 per cent. The working expenses for the year amount to £96,801 8s. 3d., which, after taking credit for the Government messages, leaves a credit to the department of £15,527 5s. 6d., or 3·73 per cent. on the capital invested. The item for cost of maintenance of stations shows an increased expenditure of rather more than £10,000 over the previous year. This is to be accounted for by the constantly increasing work of the department and the opening of new stations. Comparing the number of telegrams transmitted during the year with the letters posted during the same period, the result shows that 19·64 telegrams were sent for every 100 letters. The proportion last year was 20·71. The number of money-order telegrams sent during the year was 14,607, representing a value of £61,693 9s., being an increase over the previous year in messages 1,807, and value £6,770 18s. 7d. The commission collected by the Post Office on these transactions amounts to £1,758 9s. 4d. From this amount has to be deducted the sum of £730 7s. as fees on telegrams, which leaves £1,028 2s. 4d. to the credit of the Post Office, which is equal to 1·666 per cent. upon the total amount transmitted. During the year 109 miles of line carrying 113 miles of wire have been erected, and 296 miles of wire erected on existing lines, making the total mileage in circuit on 30th June of line 3,543, and wire 8,444. The number of stations open to the public on the 30th June was 195. Of these 16 were opened during the past year, 11 being in the North Island and 5 in the South Island. The mileage of line maintained during the year was 3,434 miles, at an average cost for maintenance of £5 0s. 9d. per mile. The "Urgent Code" referred to in the last year's report continues to increase in public favour, and is very largely taken advantage of by the mercantile portion of the community. The number of "urgent" messages transmitted during the past year was 30,106, giving a value of £4,623 7s. 10d., being an increase over the past year of 16,651 messages, and value £2,523 11s. 2d. Since the date of the last report a "Delayed" code has been introduced, and is greatly appreciated by the public. The fee for these telegrams is one-half the ordinary fee, in addition to which a postage fee of one penny is charged. These telegrams are accepted at any time throughout the day, and are forwarded to their destination and posted the same evening after the close of business, so that they may be delivered by the first postal delivery the following morning. The system was introduced on the 1st of July, 1878, and since that date 56,721 "delayed" telegrams have been transmitted, yielding a revenue to the department of £2,846 9s. 2d.

INDIAN TELEGRAPH LAWS.—The powers and privileges of Government in calling for messages sent over the telegraph wires in India, says the *Madras Mail*, are probably not generally known. Section 5 of the Telegraph Act (Act No. 1 of 1876) runs as follows:—"On the occurrence of any public emergency, or in the interest of the public safety, the Governor General in Council, or the Local Government, may take temporary posession of any line of telegraph established or maintained by any company or person licensed under this Act, or may order that any message to or from any person, or relating to any specified subject, shall be intercepted or communicated to the Government or any officer thereof mentioned in such order. If any doubt arises as to the existence of a public emergency, or whether any act done under this section was in the interests of the public safety, a certificate signed by a Secretary to the Government of India or to the Local Government shall be conclusive evidence on the point." Section 17 of the Act provides that any telegraph officer who . . . "wilfully or otherwise than by the official order of a Secretary to the Government of India or the Local Government, or of such other officer as the Governor General in Council authorises to give such order, intercepts any message or any part thereof, or divulges any message, or the purport of any message or of any part thereof, to any person not entitled to receive the same . . . shall be liable to imprisonment for a term not exceeding three years, or to fine, or to both." Section 21 runs as follows: "Whoever transmits or causes to be transmitted by telegraph a message which he knows to be false or fabricated shall be liable to imprisonment for a term which may extend to three years, or to fine, or to both." The whole of the Telegraph Act is contained in twenty-three sections. We imagine that few people are aware of the extraordinary "powers and privileges" it confers on the Government in India. That such an act would be tolerated in any British community out of India seems highly improbable. It goes without saying that these powers and privileges were never intended to be exercised except under the most exceptional circumstances, such as danger to the State, &c.; but, as the Act stands, it is left to a local Government to determine what is a matter of "public emergency," and the Act, therefore, virtually authorises a fretful or meddlesome Government to pry into the history of almost any telegram that may be printed in a newspaper. It is just as well that both senders and receivers of telegrams should be aware of this fact, so that they may take precautions accordingly.

IN a letter to the *Colliery Guardian*, Mr. Ralph Loudon, of Wenworth Colliery, Newcastle-on-Tyne, says: "During the last few weeks the magnetic needles of our galvanometers have shown their sensitiveness to the electrical changes in our atmosphere. About a fortnight ago I was rather struck on observing the leaves of a gold-leaf electroscope promptly diverge, and suddenly collapse, owing to a discharge of atmospheric electricity in our latitude.

"Several times in succession the behaviour of the electroscope was magnificent, inasmuch as I sat up late

at night recording no less than 27 charges and discharges of the leaves. This prompted me to attach by a wire one binding screw of a galvanometer to the rail of a waggon-way, which has a length of about ten miles. The other binding screw of the galvanometer I connected to the gas pipes which pass through our villages. By this means I had an earth connection of about one hundred square miles. The circuit completed, I anxiously awaited results. Scarcely had I made the connection than the needle of the galvanometer quivered to the right and left of the zero point. Sometimes a deflection was caused having an angle of there degrees. But the majority of deflections were upwards of seven degrees. Afterwards I tried a shunt, but utterly failed to register accurately the amount of deflection. At every deflection of the galvanometer the surface of the earth had its electrical condition changed. The storms were, in the majority of cases, unheard, and seldom a flash of light was seen. The surveying dial, commonly used for mine surveying, though not so sensitive as the needles of our galvanometer, was occasionally disturbed, and rendered sensitive enough to be easily repelled by the near approach of a surveying lamp.

"Having the opportunity the other day to be standing beside a mining dial, in a mine having a depth of about 170 fathoms, I stood in amazement at seeing the *north end* of the needle *repelled* by a brass Clanny lamp, having a copper gauze. Certainly, we know that cabonic acid, hydrogen, oxygen, and nitrogen, repel the magnetic needles of our surveying instruments; but not such an amount of dia-magnetism is found in the above-named gases as to be taken into consideration. Copper showing the greater dia-magnetic properties over the gases no doubt accounts fully for the behaviour of the needle, as the latter must have been particularly sensitive to the electric state of the moving current. Such phenomena, though occurring at rare intervals, give rise to a series of questions, on which the best authorities seem not at all agreed. It would appear, from the action of the various magnetic needles under these most strange circumstances, that they are ever in search of a position of rest.

"Should the magnetic curve be travelling westward in our locality, and awaiting the earth's electrical equilibrium to be restored, no doubt, at these precise moments, a number of errors can be committed, even by the most skilful and practised surveyor. Or, suppose the magnetic curve be travelling eastward, the more glaring will be the error in long and delicate surveys. The direction of the earth's magnetism has a close relation to the earth's shape; but, as we know, it is not in any way the cause of this shape, we may suppose that the figure of the earth and the rotation which causes the earth to keep this figure have something to do with the production of magnetism. At present, there seems to be some influence at work which, along with the earth's rotation, results in magnetism. What is this influence? I venture to say, the sun. The most distinguishing features of it, are chiefly these four: 1. Its rifts and general radiating appearance. 2. The crossing and bending of rays. 3. Its self-luminosity, as spectroscopic observations have shown. 4. Its changing and flickering character. After a prolonged period of solar quiescence, the disc of the sun is beginning to assume new features, and will most assuredly cause magnetic storms. The late French mathematician, Leverrier, long since pointed out the absolute necessity of care, and warned surveyors against the hasty conclusions arrived at in their surveys. Under the present circumstances, long and delicate surveys ought to be deferred, if possible."

CASE OF LIGHTNING-STROKE.—A paper was read at a late meeting of the Clinical Society by Dr. G. Wilks, of Ashford, on a remarkable case of lightning-stroke, which occurred on June 8th, 1878. A farm labourer was struck by lightning while standing under a willow tree, close to the window of a shed in which his three fellow workmen had just taken shelter from a violent storm of rain. His companions found the tree partly denuded of its bark, and the patient's boots standing at its foot. The patient himself was lying on his back two yards off, and though he was fully clothed previously, he was now naked, with absolutely nothing on except part of the left arm of his flannel vest. He was conscious, but much burnt, and his leg was badly broken. The field around was strewn with fragments of the clothing; the clothes were split or torn from top to bottom, the edges of the fragments being often torn into shreds or fringes; they only showed evidences of fire where they came in contact with metal, such as his watch and the buckle of his waist-belt. There were no laces in the boots. The left boot was torn and twisted into fantastic shapes, but the sole was uninjured, and there was no signs of fire upon it; the right boot had the leather much torn and the sole rent and burnt. The watch had a hole burnt through the case, and the chain was almost entirely destroyed. The stockings were split down the inner side; the hat was uninjured. The patient stated that he was struck violently on the chest and shoulders, became enveloped in a blinding light, and was hurled into the air, coming down on his back "all of a crash," and never losing consciousness. The hair of his face was burnt, and the body was covered with burns. Down each thigh and leg was a broad crimson indurated band of burning, passing along the inner side of the knee, and ending below the left inner ankle and at the right heel; a lacerated wound, with a comminuted fracture of the os calcis. The bones of the right leg were fractured, and the tibia protruded through the skin in the course of the burn. He was discharged healed twenty weeks after the occurence. Dr. Wilks remarked on the almost complete exemption of the nervous system and on the probability that the clothes being wet acted as good conductors, and so diverted the electric current from the great nervous trunks, thus saving the man's life.

STEELING COPPER PLATES.—R. Bottger uses 100 parts of ammonio-ferrous sulphate, and 50 parts of ammonium chloride dissolved in 500 parts of pure water, a few drops of sulphuric acid being added; the liquid is maintained at 60° to 80°, and the copper plate is immersed in this liquid and made the cathode of a battery of 2 or 3 Bunsen cells, the anode being an iron plate equal in size to the cathode. In a few minutes a hard steel-like deposit of iron is formed on the copper plate.

INDIA-RUBBER TRADE AND MANUFACTURE.—In an interesting article in *The Journal of Applied Science* occurs the following: The average annual import of gutta-percha is only from 20,000 to 25,000 cwt., and has apparently reached its maximum quantity; while the supply of india-rubber continues steadily to increase. This is best shown by a comparison of the average quinquennial receipts of the two substances:—

Average of Five Years ending	India-rubber. Cwts.	Gutta-percha. Cwts.
1856	27,598	19,846
1861	33,864	19345
1866	67,989	23,957
1871	134,993	21,538
1876	151,194	21,577
1878	149,724	32,912

A tabular statement of india-rubber imported into

the United States in the years ending June 30th is also given, these imports being nearly all derived from Brazil.

Year.	Quantity.	Value in Dollars.
1868	8,438,000	2,180,336
1869	7,813,000	2,505,632
1870	9,624,000	3,459,665
1871	6,155,000	2,307,233
1872	11,803,000	4,789,590
1873	14,536,978	4,900,550
1874	14,191,320	6,196,729
1875	12,035,634	4,675,490
1876	10,589,297	4,063,659
1877	13,821,109	5,542,166
1878	12,512,203	4,711,108

NATURAL ELECTRO-PLATING.—Some specimens of minerals collected in South America by M. Fremier, who was for some time director of the silver mines at Caracoles, have been examined in Paris by M. Jannettaz, who has discovered among them an extraordinary example of an ammonite transformed into native silver. It was found with a number of other ammonites belonging to the two species *A. peramatus* and *A. plicatilis*, but these had not been mineralised with silver salts. The ammonite in question has, on the other hand, been entirely replaced by chloride of silver, which has been partially reduced to the metallic condition. Light is thrown by this specimen upon the origin of the native silver which occurs in the Caracoles mines, for it is only fair to infer that this metal has, in like manner, been reduced from the state of chloride at a period not earlier than the deposition of our Oxford clay. The description of the ammonite in silver will be found in a recent number of the *Bulletin* of the Geological Society of France.

FISH KILLED BY ELECTRICITY.—The *Nassauer Bote* states that during a very heavy thunder and hail storm at night time, a flash of lightning struck a small pond at Seck, in the Grand Duchy of Nassau, well stocked with various kinds of fish, the property of the pastor of the parish. The following morning the whole of the fish were discovered dead upon the surface of the water. They had all the appearance of having been half boiled, and crumbled to pieces at the least touch, just as is the case with fish after being boiled. Neither any external nor internal injury could be observed, the scales being intact and the swimming bladder filled and well preserved. The water in the pond was still muddy and dull the morning after the storm, as if the lightning had only then struck it.

THE TORPEDO EXPLOSION.—A few days ago an inquest on William Southey, able seaman, who died from injuries received from an explosion of countermines in Fareham Creek, was held at Gosport. Deceased was one of a countermining party sent out from her Majesty's ship *Vernon* for torpedo instruction, and when only three mines in one line had been stopped an explosion of all in the circuit took place. The charges in each consisted of three pounds of powder in a case. A piece of tin struck Southey on the head, inflicting a severe wound. Three of the men were injured. The evidence of Lieutenant Frank Henry Rogers, of the *Vernon*, who was out with the countermining party, went to show that while the mines were being laid, and before the flag was dropped, an explosion took place. On going on board the battery boat, in charge of Mr. Macdonald, gunner, he found the main wire joined to the positive pole of the battery, and that the firing key, which ought to have been on the positive pole of the battery, was on the negative pole. The return wire being disconnected, and held in a man's hand, and the main wire being joined up in that manner, was highly dangerous.

New Patents—1879.

5242. "An improvement in the manufacture of matrices for the production of electrotypes and stereotypes, and in type printing, whereby the operation of setting-up type may be dispensed with." G. D. MACDOUGALD. Dated Dec. 23.

5254. "Construction of posts or supports for railway signals and telegraph wires." J. S. WILLIAMS. Dated Dec. 23.

5270. "Improvements in apparatus for operating or adjusting and securing railway switches, crossings, and signals, or parts connected therewith." J. S. WILLIAMS. Dated Dec. 24.

5297. "Improvements applicable to signals used on railways." H. JOHNSON. Dated Dec. 27.

5319. "Improved telephonic exchange system and apparatus for effecting telphonic communication." E. DE PASS. (Communicated by the Law Telegraphic Company.) Dated Dec. 30.

5335. "Telephones." A. WHITE. (Communicated by T. A. EDISON.) Dated Dec. 31.

5337. "Improvements in automatic switches for telephones and other electrical apparatus." A. M. CLARK. (Communicated by E. T. Greenfield and D. McL. Adee.) Dated Dec. 31.

1880.

5. "Magnetic curative appliances." F. BAPTY. Dated Jan. 1.

18. "Electric lamps." J. W. SWAN. Dated Jan. 2.

33. "Improvements in apparatus for developing electric currents and regulating the action of the same, in circuits that pass to electric lights or electro-magnetic engines." T. A. EDISON. Dated Jan. 3.

75. "Improvements in dividing and apparatus for regulating the electric light." A. M. CLARK. (Communicated by L. Roguier.) Dated Jan. 7.

79. "Improvements in apparatus for producing and utilising electric currents, and in lamps to be employed in connection with the same or similar apparatus." R. WERDERMANN. Dated Jan. 8.

91. "Microphonic and telephonic apparatus." W. R. LAKE. (Communicated by E. Berliner.) Dated Jan. 8.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1879.

1959. "Improvements in electric lamps." JOHN HOPKINSON. Dated May 6. 4d. This relates to that class of electric lamp in which the arc is used, and in which the current passing is maintained constant by means of an electro-magnet, through which the current passes on its way to the electric arc. Points of the main circuit are connected on opposite sides of the electric arc by a fine wire, forming a solenoid or electro-magnet. The current in this fine wire is proportional to the difference of electric potential on the two sides of the lamps. When the carbons are so far parted that this difference is greater than the proper amount, the solenoid or electro-magnet of fine wire actuates a connection, whereby the electro-magnet of the lamp itself is short-circuited, and is caused to permit the carbons to approach. The result of this arrangement is that the lamp maintains the difference of electric potential on the two sides of the arc constant, instead of maintaining the quantity of the current constant.

1994. "Electric bell apparatus." H. J. KIRBY BOUCHETTE and JOSEPH ALDRIDGE. Dated May 20. 2d. This combines bells and pushes in one block, so that persons may communicate between various rooms and places, and so that the person to whom the signal is sent may also send signals himself either to one or a number of rooms. (*Not proceeded with.*)

2000. "Electric lamps." JOSEPH COUGNET. Dated May 20. 2d. The action of the lamp is as follows:—The two poles or carbons being nearly in contact one with the other, a suitable electric current is caused to pass through an electro-magnet and to the positive pole, from which it passes to the negative pole. As long as the said carbon is in a condition to produce the electric light, a lever or armature is attracted to the electro-magnet, and resists the action of a weight which tends to raise the said carbon; but as soon as a sufficient portion of the carbon is consumed, the electric current passes with less intensity, and the lever or armature is set nearly free, and allows of the positive carbon being raised to the required extent, when the lever or armature is again attracted to the electro-magnet, and causes the feed of the carbon to cease. (*Not proceeded with.*)

3577. "Signals for telephone and telegraph lines." WILLIAM THOMAS WHITEMAN. (A communication from abroad by Samuel Ward Francis of Newport, Rhode Island, U.S.A.) Dated September 5. 6d. Are designed so that any one station can call the central station, or be called, without disturbing the others.

City Notes.

Old Broad Street, Jan. 13th, 1880.

WESTERN AND BRAZILIAN TELEGRAPH COMPANY, LIMITED.—The seventh ordinary general meeting of this company was held January 8th, at the City Terminus Hotel, Sir EDWARD WATKIN, M.P., presiding. The report of the directors, which was taken as read, stated that the receipts for the past year were £92,733, showing a decrease of £148 as compared with the previous year. Under their agreement with the Brazilian Submarine Company, the latter have raised the question whether, owing to the long and repeated interruptions to the traffic, the Western Company were entitled to share in the revenue of that company during the continuance of such interruption. This was compromised by their consenting to deductions amounting to £7,069, but for which, and others of smaller amount, the revenue would have reached a sum of £106,882. The expenses on general account was £27,615, against £31,297 last year. The measures taken for repairs with sheathed cable in shallow water had resulted in a great improvement, but there was more work to be done in the same direction. The cost of maintenance and renewals in 1877-78 was £69,194, but in 1878-79 the outlay was £72,104. The directors proposed to charge direct to revenue £24,270, under the head of maintenance, and to carry the balance of revenue, amounting to £19,926, to renewal account. This, with the balance standing to the credit of that account, and the balance of revenue from last year of £3,263, making together £43,866, would leave a small balance of £3,967 to carry forward as a debt to the renewal account of the current year. The receipts for the first ten weeks of the current quarter averaged £2,900 per week, showing, after certain payments, a yearly revenue of £126,490 to the company.—In moving the adoption of the report, the CHAIRMAN said that, briefly summarised, it showed a net revenue of about £40,000, after charging £24,000 to renewal of cables. They generally calculated that a cable should be worked at a cost of 25 or 30 per cent. but theirs had cost 60 per cent., because they had no margin of capital to carry out the extensive renewals necessary in some parts of their system. In order to cure that, and bring about a state of things by which the ordinary shareholder would receive a share in the profits, it was necessary, firstly, that they should pay their debts; secondly, that they should complete the renewal of their cables; and thirdly, that they should have a margin of securities to meet other liabilities. He proposed a scheme by which they could become their own mortgagees, which had met with considerable response, and he believed that, with the assistance of some influential shareholders, they had to-day made an arrangement to provide capital for paying their debts, renewing their cables, and meeting the various classes of debentures falling due next August. That would be the result if the arrangement accepted in principle did not break down in detail, and he thought it by no means unsatisfactory. In conclusion, he referred to certain antagonism they had received from Brazilian officials, which they had every reason to believe was now got rid of by the action of their secretary, who was visiting that country.—Mr. MENDEL seconded the motion, which was carried *nem. con.*—A vote of condolence with the family of Mr. Rawson, the late chairman of the company, upon the decease of that gentleman, was passed; and the retiring directors and auditors having been re-elected, the meeting closed with the customary compliment to the chairman.

THE Globe Telegraph and Trust Company (Limited), notify that interim dividends for the quarter ending January 18th, 1880, of 3s. per share on the preference shares, being at the rate of 6 per cent. per annum, and 2s. on the ordinary shares, being at the rate of 4 per cent. per annum, both free of income tax, will be paid after the 19th inst.

THE directors of the German Union Telegraph Company have declared an interim dividend of 11s. 9d. per £15 bond.

The following are the final quotations of telegraphs for Jan. 13th:—Anglo-American, Limited, 58-58½; Ditto, Preferred, 83-83½; Ditto, Deferred, 33-33½; Brazilian Submarine, Limited, 7½-7⅝; Cuba, Limited, 8⅝-9; Cuba, Limited, 10 per cent. Preference, 15½-16½; Direct Spanish, Limited, 1¾-2¼; Direct Spanish, 10 per cent. Preference, 11-11½; Direct United States Cable, Limited, 1877, 11-11¼; Eastern, Limited, 8⅛-8⅜; Eastern, 6 per cent. Debentures repayable Oct., 1883, 103-106; Eastern 5 per cent. Debentures repayable Aug., 1878, 102-105; Eastern, 6 per cent. Preference, 11¾-12; Eastern Extension, Australasian and China, Limited, 8⅛-8¼; Eastern Extension, 6 per cent. Debenture, repayable February, 1891, 106-109; 5 per cent. Australian Gov. Subsidy Deb. Scrip, 1900, 100-102; Ditto, registered, repayable 1900, 100-102; German Union Telegraph and Trust, 8¼-9¼; Globe Telegraph and Trust, Limited, 5-5¼; Globe, 6 per cent. Preference, 11¼-11½; Great Northern, 8¼-9½; Indo-European, Limited, 23-24; Mediterranean Extension, Limited, 2¾-3¼; Mediterranean Extension, 8 per cent. Preference, 10¼-10½; Reuter's Limited, 10-11; Submarine, 230-235; Submarine Scrip, 2¼-2⅝; West Coast of America, Limited, 1¼-1½; West India and Panama, Limited, 1½-1¾; Ditto, 6 per cent. First Preference, 7¼-8; Ditto, ditto, Second Preference, 6¾-7¼; Western and Brazilian, Limited, 5⅛-5⅜; Ditto, 6 per cent. Debentures "A," 100-103, Ditto, ditto, ditto, "B," 98-102; Western Union of U.S. 7 per cent., 1 Mortgage (Building) Bonds, 120-125; Ditto, 6 per cent. Sterling Bonds, 105-107; Telegraph Construction and Maintenance, Limited, 35-36; Ditto, 6 per cent. Bonds, 106-108; Ditto, Second Bonus Trust Certificates, 2¾-3; India Rubber Co., 12¾-13¼; Ditto, 6 per cent. Debenture, 105-107.